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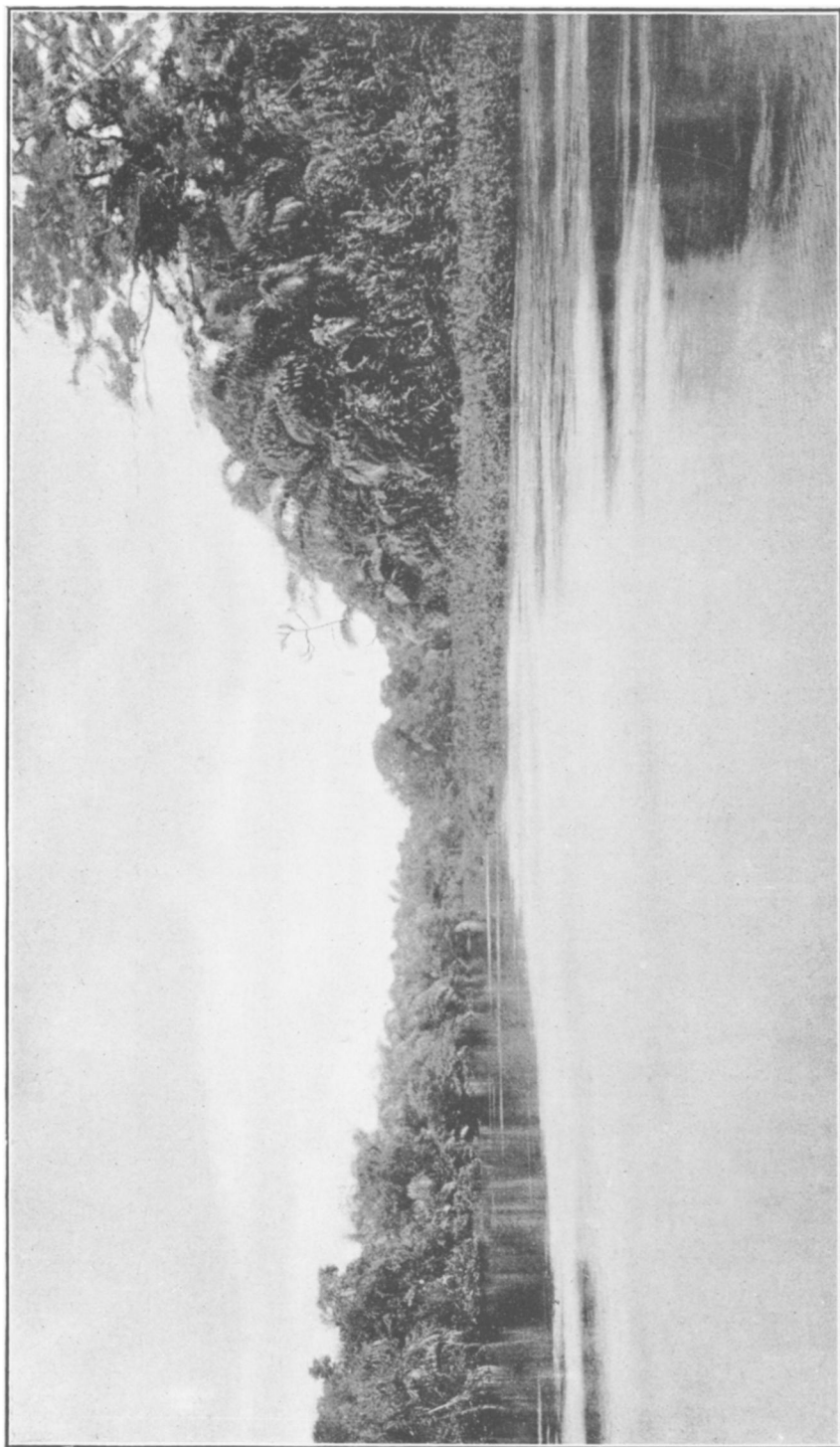
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SAN JUANILLO RIVER

THE RIO SAN JUAN DE NICARAGUA.*

BY

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Two thousand miles from New York Harbor, and eight hundred miles southwest from a steamer rounding the eastern end of Cuba, there empties into the Caribbean Sea a river which, from its physical characteristics, its history and associations, and its inevitable future, is unique among the rivers of this hemisphere; the Rio San Juan de Nicaragua.

That Nicarao, Diriangen, and the other caciques whom Avila in 1522 found reigning west of Lake Cocibolca (Nicaragua) were aware of the existence of this river seems probable; but that there were ever villages along its banks or that these chiefs knew more about it than the vaguest rumors, is very doubtful.

Even after its discovery, the absence of history's mordants, gold and blood, has left the story of the river for years scarcely less vague and uncertain than before.

When Columbus in his fourth and last voyage doubled Cape Gracias á Dios, on the 14th of September, 1503, he sailed directly south along the coast, about sixty-two

*Not having had time or opportunities for access to original documents, the historical notes in the following paper are drawn principally from Lévy's "Nicaragua," Squier's "Nicaragua," and Irving's "Voyages of Columbus."

The remainder of the paper and the charts are based upon the work of the various Government Expeditions from 1871-1884, and the writer's personal experience in the Expeditions of 1884-85 and 1887-88.

R. E. P.

leagues, and on September 16th anchored near a copious river. A boat sent in for wood and water was swamped on the bar when returning to the ship and lost with all on board. In memory of this event Columbus named the river Rio del Desastre.

Leaving this river he continued for several days along the coast, until on the 25th of September, with his ships nearly disabled by storms, he anchored between a small island and the mainland in a delightful and commodious situation. "Immediately opposite, at a short league's distance was an Indian village, Cariari, on the bank of a beautiful river. The country around was finely diversified by noble hills and forests, with trees of such height that Las Casas says they appeared to reach the skies."*

October 5th the fleet left Cariari, and after sailing twenty-two leagues to the eastward entered Almirante Bay at the western extremity of Chiriquí Lagoon. Both Cape Gracias á Dios and Almirante Bay retain their names to the present day and are well-known places.

The intermediate localities above mentioned are doubtful.

Twenty-two leagues northwesterly from Almirante Bay falls very near to Port Limon, Costa Rica, and sixty-two leagues south of Cape Gracias á Dios brings us about half way between the mouth of Bluefield River and Monkey Point. Between the points thus located is a stretch of coast one hundred and ten miles in length. Some writers have supposed the Rio Del Desastre and the San Juan to be the same. Lévy however considers the Rio Grande de Matagalpa to be the Rio del Desastre, and places Cariari at the mouth of the Rio Rama.

*Irving's Voyages of Columbus.

This last theory makes two circumstances difficult of explanation.

1. How so acute an observer and skilful a navigator as Columbus, could have failed during the nine days of storm, which on the above assumption he must have passed off the coast between the Rio Grande and the Rio Rama, to discover and run into some one of the numerous sheltered lagoons which extend along this entire portion of the coast.

2. How the same skilful navigator could have made so gross a mistake as to estimate one hundred and sixty miles at twenty-two leagues.

It is much easier to imagine that before a favorable wind and aided by the doubtless undetected southerly current which runs along that coast, he would underestimate his progress after leaving Cape Gracias á Dios, forty miles in a total distance of two hundred and fifty, particularly if, as was doubtless the case, his was dead reckoning.

This last hypothesis would make the Rio del Desastre and the San Juan the same, and would locate the nine days of tempest off the coast between the mouth of the San Juan and Port Limon, which seems more probable.

The copious flood mentioned would, on the whole, rather point to the San Juan, while the absence of any mention of a harbor at the mouth of the river would not militate against the theory, as it is by no means certain that the harbor of San Juan del Norte, or Greytown, is not a formation since the time of Columbus.

On this hypothesis Columbus was the first European to look upon the waters of the grand Rio.

If, on the contrary, we assume Columbus's estimates of distance as correct, then we are forced to the conclusion that the honor belongs to another.

Gil Gonzales de Avila, the discoverer of Nicaragua, supposed that the Lagoon Cocibolca (Lake Nicaragua) discharged into the North Sea. He, however, was prevented from deciding the question by a war then in progress between some of the native chiefs.

About 1528 Martin Estete partially explored the outlet of Lake Nicaragua, and named it the Rio San Juan. Estete, however, was unable to pass the rapids, as the river was very low.

In 1529 Diego Machuca, a resident of Granada, built boats upon Lake Nicaragua, and after circumnavigating the lake, descended its outlet to San Juan. He passed the rapids which had stopped Estete the previous year, reached the Atlantic with the same vessel in which he had weighed anchor at Granada, and then sailed along the coast to Nombre de Dios.

Oviedo, writing in 1540 of this exploration, states that Machuca advanced by land at the head of two hundred men, taking the same course as the boats. Machuca gave his name to the rapids in the river, and gave the name of San Juan de las Perlas to the port which he found at the mouth of the river.

In 1551 the historian Gómara indicated the Rio San Juan and the Lake of Nicaragua as one of the most practicable routes for water communication between the North and South Seas.

In 1570 the commerce of Central America was carried on by the South Sea, the pirates permitting no navigation of the North Sea except from the ports of

Vera Cruz or Cartagena, from whence ships sailed convoyed by vessels of war. But in 1579 the pirates penetrated into the South Sea also, through the Straits of Magellan, and in 1583 Realejo was fortified in expectation of an attack.

Commerce then found an outlet by way of the Nicaragua Lake and the Rio San Juan and waiting in the lower river until the coast was clear, the vessels sallied forth and kept along the shore to Nombre de Dios or Cartagena. Granada thus acquired a great supremacy in the internal commerce of Central America. The resulting prosperity, which drew upon the city many misfortunes, reached its climax in 1592. Vessels of eighty to one hundred and twenty tons, and some even larger, plied between Granada and Nombre de Dios, Havana, and Cadiz. This rich traffic could not fail to attract the attention of the rapacious and ever-alert pirates. For a long time they threatened to ascend the river to the lake, and finally, in 1665, a party under Davis succeeded in doing so, and captured San Carlos and Granada. Immediately after their retreat a redoubt was erected at Santa Cruz, now Castillo, and another at Toro, and, in addition, these two already difficult passages were ordered to be still further obstructed with rocks. Other defensive works were erected along the river, but in 1670 the pirate Gallardillo penetrated to the lake in spite of all resistance, dispersed the inhabitants of the settlement behind the fort at San Carlos, and devastated several settlements along the shore.

Then was ordered the construction of a castle at the rapids at Santa Cruz, which upon the completion of the work was called the Rapids of Castillo. At the

same time some dozen fortified stations were established along the river; and the channel of the Colorado at the place where it leaves the main river was widened in order to diminish the quantity of water which passed through the San Juan.

The river was now so well fortified that the pirates could no longer ascend it, but that did not prevent them from watching its mouths. The current of commerce was interrupted, and the prosperity of Granada began to decline. The capture of the city by L'Olonnais, in 1685, gave it its death blow.

In 1769, the English entered the river, but were unable to ascend beyond Castillo. In the attack upon the fort the Commandant Herrera was killed, but his daughter, a señorita of eighteen years, took command and repulsed the attacking force.

In 1780, another English expedition of two hundred men, under Polson and Nelson, moved up the river and captured Ft. Castillo.

In 1796, the port of San Juan, at the mouth of the river, was made a port of entry by royal order of the King of Spain.

Thirteen years later, in 1809, there appeared in Madrid, in the *Portulano de la Setentrional* the first published map of the port, of which we have any knowledge.

In 1832, a French survey of the harbor was made.

In 1848, a third English expedition ascended the San Juan to the mouth of the Sarapiquí and dislodged a Nicaraguan force there.

In 1850-51, the first scientific survey of the river was made by Childs.

In 1851, an American company began running steamers from the mouth of the river up to and across the Lake, and in the next few years carried thousands of passengers and large quantities of treasure across the Isthmus. The construction of the Panama R. R. drew all the passenger traffic away, but with some interruptions and various changes of owners, steamers have been running from the harbor of San Juan to ports on the Lake up to the present time. There is now plying upon Lake Nicaragua a twin-screw steamer capable of carrying one hundred and fifty tons, which steamed from Wilmington, Del., where she was built, up the San Juan to the Lake.

Since Childs's survey the river has been repeatedly surveyed in connection with the interoceanic problem, until now there is hardly a river in the United States of which we have more accurate knowledge.

To those fond of analogies the San Juan and its lakes present a very striking counterpart in miniature of the St. Lawrence and its lakes.

The physical peculiarities of this river and its basin have naturally led to various theories as to their causes. The most interesting one is that the Lakes Nicaragua and Managua and the San Juan occupy the lowest portions of the elevated bed of what was once a broad strait stretching N. W. and S. E. between the two oceans. This is given by Lévy, but whether it originated with him or not I am unable to say.

Whether this theory be true or not only a thorough study of the comparatively unknown geology of the country can determine; but plausible it certainly is as one cannot fail to admit who stands upon the roof of the Cathe-

dral of Leon and sees the great plain of Leon spreading like a floor from Lake Managua to the Pacific, then traverses the two lakes and the Rio San Juan to the mouth of the San Carlos, and from an elevation of a thousand feet at this point looks E. and S. E. to the Caribbean across forty miles of forest, level as a floor, covering a V-shaped section of low swampy country once evidently an arm of the sea, now besprinkled with lagoons and intersected by tortuous, sluggish streams. Previous to this elevation of the land the waves of the Caribbean doubtless beat against the bases of the San Carlos mountains, and the spurs that come to the north bank of the San Juan from the Rio San Carlos to the San Juanillo.

The *embouchure* of the San Juan is at the northwestern extremity of a stretch of coast one hundred and fifty miles long, which forms the bottom of the Gulf of Veragua, and lies in an almost straight line perpendicular to the constant rush of the northeast trades across the Caribbean Sea.

Northerly the coast trends east of north two hundred and forty miles to Cape Gracias á Dios, and throughout the entire distance from Cape Gracias á Dios to Chiriquí Lagoon there is a strip of varying width of flat, swampy, lagoon dotted country, formed of the detritus pushed out from the ragged edges of the gaunt, volcanic skeleton of the Isthmus by the numerous rivers.

Though this coast has grown out into a practically tideless sea, it is interesting to note how the constant rush of the trade winds and the accompanying uninterrupted hammering of the waves, in a single direction, have moulded the coast line and given it features very similar to those of our own coast south from New York.

In one place the sands are shifted along the shore and all the river mouths are deflected in the same direction ; in another the sand is beaten directly back upon the coast to form a narrow, cordon littoral.

On approaching the coast the shore appears low and unrelieved for miles into the interior, where blue hills can be seen rising above the trees. On the right, the high blue mountains of the Mosquito Coast are visible, and directly ahead, if the day be clear, tower the mighty turquoise masses of the Costa Rican volcanoes.

Crossing the bar and traversing the harbor lagoon to Greytown, a flat-bottomed, stern-wheel steamer offers the means of navigating the river. For three or four miles from the harbor, as far as the mouth of the San Juanillo, which enters from the right, the course of the river is comparatively direct, there is always a good depth of water, and the stream is bordered on both sides by a broad strip of luxuriant zacate grass, the home of alligators, *garzas* or white herons, and numerous small birds.

The San Juanillo, which drains a large section of low lagoon country, is at its confluence with the San Juan a larger stream than the latter, and could easily be mistaken for the main stream. The view up the San Juanillo at this point is characteristic and beautiful in the extreme. On one side of the long, curving stretch of the stream at this point is a ribbon of zacate grass, even and regular, waving like a field of grain, on the other a continuous wall of the graceful, glistening fronds of the silico palms tossing and rustling in the wind.

Five miles above the San Juanillo the Tauro mouth leaves the San Juan and flows N. E. to the coast, three

miles below the harbor. From here to the junction with the Colorado the Lower San Juan is cut by numerous islands into a labyrinth of channels. The banks are firm, but there is no sign of hill on either side until the last bend previous to passing from the Lower San Juan into the main river.

Emerging from the San Juan, a broad, straight expanse of river lies ahead with banks wooded to the water's edge, and over the trees, where the river bends to the southward again, looms up the mass of El Gigante, an isolated mountain ganglion, in whose steep ravines the San Juanillo has its source.

From this point to the mouth of the Sarapiquí, a distance of thirteen miles, the river has an average width of fourteen hundred (1400) feet widening to two thousand (2000) feet at several places where groups of low islands divide the stream into several channels.

Five miles above the junction of the San Juan and Colorado is the upper mouth or inlet of the San Juanillo, a narrow, almost grass-hidden canal on the north bank. This San Juanillo will receive further attention later on.

Just below the mouth of the Sarapiquí we have another fine view of El Gigante. Above the mouth of the Sarapiquí the stream is very much contracted by the rocky hill which comes to the river from the north at this point and the current is swift and powerful.

It is an interesting fact that throughout this portion of the San Juan, as well as along the Lower San Juan, there is no lateral drainage into the river. There are many sandbanks along this portion of the river, and during the dry season the steamer channel becomes very tortuous.

At the mouth of the Sarapiquí the river changes its hitherto S. W. general direction and stretches away almost due N. W. for a distance of eight miles to the mouth of the San Francisco, on the north bank; thence it bends south, southwest, west, northwest, north, etc., in several long loops, the resultant direction being nearly due west to the mouth of the San Carlos, twenty-three miles by the river from the mouth of the Sarapiquí; and the average width throughout this section is rather less than in the previous one, being about eleven hundred (1100) feet, and the islands occur singly rather than in groups. Heavily wooded hills come to the river on the north bank at several places, and from the upper deck of the steamer glimpses of others are obtained over the tops of the trees which line the river bank.

The south bank of the river is continuously low to within a few miles of the San Carlos; throughout this section there are, in the dry season, numerous banks, and the depth of water is about the same as in the section below the Sarapiquí. There are also numerous tributaries or *caños* on both sides, those on the south, the Copalchi, Trinidad, and Cureña, sluggish, excessively tortuous streams draining interior lagoons; those on the north the *caños* Guasimos, Tamborcito, Tamborgrande, San Francisco, Danta and Machado; streams, which having their sources in the hills to the north, flow, with the exception of the Machado, through triangular pockets of level swampy ground before discharging into the San Juan. These pockets are usually several miles in depth and their surface is from twelve to twenty feet above the average low-water stage of the river.

Steaming up the straight reach of the river, below the mouth of the San Carlos, the first grand scenery on the river is encountered. Here directly ahead towers the symmetrical mass of the San Carlos mountain with its three flanking conical peaks. This mountain, not less than fifteen hundred (1500) feet in height, guards the lower entrance of the mountain section of the San Juan, and as the steamer makes for it until it seems scarcely a stone's-throw distant, and there is no perceptible break in the dense line of forest which extends on both sides and apparently directly across the river, we wonder if the river bursts full-grown from the earth. Suddenly the steamer swerves to the left till it heads S. E. up the San Carlos, then as suddenly to the right, and, passing close under the shadow of the mountain, enters the narrow, deep, almost currentless cañon of the Agua Muerta. The river for the next thirty-six miles with its numerous turns, its steep mountain slopes rising sharply from the river's edge, its constantly changing succession of mountain scenery is, as Squier says, a tropical Highlands of the Hudson.

Sixteen miles from the mouth of the San Carlos are Machuca Rapids; these rapids, which, at times of high river, are nearly obliterated by the volume of water from above and the backing up of that from below, become during the low-water stage of the river, by reason of the force of the current and the tortuous character of the channel, perhaps the most serious obstruction in the river. Four and five miles above Machuca are Balas and Mico Rapids, and six miles above the latter, Castillo Rapids, at the upper entrance of the mountain defile of the "Desaguadero."

The tributaries throughout this section though numerous are comparatively small and torrential in character ; from the steepness of their descent, however, they would furnish a large and valuable water-power which could be utilized throughout a large portion of the year. On the north bank they are the Santa Cruz del Norte, the Machuca, Mono, Chiquito, Bartola and Castillo, on the south the Siroma and Costa Rica.

The difference between the characteristics of this section and those of the previous one is very marked. The river is much narrower, the average width being six hundred and fifty (650) feet ; there are no islands except small ones at the rapids ; the current, except at the rapids, is slight and at times imperceptible, and the depth in many places is forty to sixty and even seventy-five feet. Above Castillo the character of the river changes again, the tall trees matted with vines so common in the mountain section disappear, the forest growth, though still dense, is less even and coherent, the hills withdraw to such a distance from the river as to be entirely invisible, and the banks are fringed with zacate grass and the feathery silico palms such as grace the banks of the San Juanillo.

Nine miles above Castillo are the so-called Toro Rapids which seem to be merely a bank of loose stones many of which are petrifications, the same in character as those found several miles up Závalo River, the first tributary above Toro on the north bank of the San Juan River. These stones are also said to be of the same nature as those found in Lake Nicaragua and to have been swept here by the current of the river. The average width of the river from Toro to the Lake, a

distance of 26.9 miles, is eight hundred and twenty (820) feet. The average depth is fourteen (14) feet at low river. The tributaries of the river in this section are the Závalo, Palo de Arco, Melchora on the north bank; the Chico, the Raudal and the Medio Queso on the south bank.

At the head of the river on its northern bank is the village of Ft. San Carlos, climbing from Lake Nicaragua on one side and the river on the other up a low hill and back to the ruins of the old fort.

From the bastions of the old fort the eye wanders westward over a wonderful tropical lake, a grand reservoir about twice the size of Long Island Sound.

Out of the bosom of this lake rises Ometepe, a typical volcanic cone, perfect in its tapering symmetry, and across the blue expanse blow constantly the beneficent Trades. West of the Lake the watershed of the river extends to within eight miles of the Pacific.

Southwest the mighty mountain masses of Miravalles, Orosi, Rincon de la Vieja, Poas, Irazú and Turrialba in Costa Rica, which peered down upon us for an instant here and there as we ascended the river, rise in uninterrupted grandeur.

Southeast, east and north the interminable forest reaches up close to the river and the village.

Ft. San Carlos is almost equally distant from the Atlantic and the Pacific, being in an air line fifty-four miles due west from the coast of the Caribbean above the mouth of the Rio Indio, and fifty-two miles due east of the head of Salinas Bay.

The level of the Lake here at low stage is one hundred and three feet above mean sea level; at its high-

est stage it reaches one hundred and ten feet ; its average annual fluctuation is, however, only about five feet. Thus, the river one hundred and twenty miles long, as we have seen, has an average fall from the Lake to the sea of from eleven to ten inches per mile. This fall, however, is quite irregularly distributed, as follows :

From the Lake to Toro, - - - - -	1.65 inches fall per mile.				
Over Toro, - - - - -	37.30	"	"	"	"
From foot of Toro to head of Castillo, - - - - -	2.93	"	"	"	"
Over Castillo, - - - - -	83.38	"	"	"	"
From foot of Castillo to head of Machuca, - - - - -	19.08	"	"	"	"
Over Machuca, - - - - -	63.61	"	"	"	"
From foot of Machuca to mouth of San Carlos, - - - - -	.90	"	"	"	"
" Mouth of San Carlos to the Sea, - - - - -	11.50	"	"	"	"

The volume of discharge of the upper river at the end of the dry season (the mean of six gaugings from above Toro to above the mouth of the San Carlos, May, 1873) is twelve thousand two hundred and eighty-six (12,286) cu. ft. per second.

The volume of discharge of the lower river, May, 1873, was above the Sarapiquí fourteen thousand five hundred and seventy-two (14,572) cu. ft ; of the Sarapiquí itself, two thousand two hundred and fifty-five (2255) cu. ft. per second ; below the Sarapiquí, sixteen thousand seven hundred and seventy (16,770) cu. ft. per second. The Lower San Juan, after leaving the Colorado, six hundred and seven (607) cu. ft. per second ; the Colorado, after leaving the San Juan, sixteen thousand one hundred and ninety (16,190) cu. ft. per second. The gaugings of Childs in 1851, of West in 1865, and of Howard in 1866, give the volume of discharge of the San Juan above the bifurcation of the Colorado, twenty-two thousand five hundred and twenty-eight (22,528) cu. ft. per second, of which twenty thou-

sand seven hundred and forty-three (20,743) cu. ft. passed into the Colorado, and one thousand seven hundred and eighty-five (1,785) into the Lower San Juan. In the wet season Childs found fifty-four thousand three hundred and eighty (54,380) cu. ft. per second, forty-two thousand and fifty-six (42,056) cu. ft. going to the Colorado, and twelve thousand three hundred and twenty-four (12,324) cu. ft. to the Lower San Juan.

Looking back now over the river, it is seen that it is easily divided into two principal divisions: first, the Upper river, from the Lake to the mouth of the San Carlos, comparatively narrow, deep, free from islands, with no obstructions, and with but little current except at the Rapids. Second, the Lower River, from the mouth of the San Carlos to the sea, broad, shallow, filled with numerous islands, and during the dry season obstructed by frequent sandbanks.

Nothing shows the difference in regimen between the Upper and Lower river more conclusively than the comparison of the high and low water stages of each, viz.: Upper river low water, eleven thousand three hundred and ninety (11,390) cu. ft. per second; high water, eighteen thousand and fifty-nine (18,059) cu. ft. per second, an increase of 59 per cent.; Lower river, sixteen thousand seven hundred and seventy (16,770) cu. ft. above bifurcation in dry season, and fifty-four thousand three hundred and eighty (54,380) cu. ft. in wet season, an increase of 224 per cent.

Throughout the year the fluctuations of the Upper river are very gradual, and during the dry season the water level is nearly constant.

In the Lower river the reverse holds good, the result

of the contributions of the San Carlos and Sarapiquí. Even in the height of the dry season, and without any rain having fallen in the valley of the San Juan, rains in the Costa Rican mountains will send enough water down the San Carlos to raise the San Juan two or three feet.

These San Carlos freshets may always be distinguished by the amount of driftwood brought down.

As already noticed, the maximum range of the river at the Lake is seven feet. Below the San Carlos it is about fifteen feet, and below the Sarapiquí twenty-five feet.

These extreme ranges, however, do not occur suddenly, nor even in the same year. The sudden fluctuations of the river, *i. e.*, those occurring in one day, may be said in no case to exceed five feet.

The delta section of the river is particularly interesting to the student of the regimen of rivers.

The Rio San Juanillo has been shown in all previous charts and described in all previous reports as a cut-off or secondary branch of the San Juan. Recent surveys have shown that the San Juanillo is really an independent stream having its source in the ravines of El Gigante opposite the mouth of the Sarapiquí. Under the name Rio Negro it flows nearly parallel with the San Juan for several miles, and then receiving an accession of volume through a narrow canal from the San Juan, it bends away to the north. The San Juanillo may always have been an independent stream, but peculiar features of drainage and topography in that vicinity have suggested the idea that the above-mentioned narrow canal between the San Juan and the Rio Negro is the remains of the original channel of the San Juan

which once flowed about where the San Juanillo does at present, the Rio Negro being then a tributary of the San Juan.

At that period, doubtless, the sea occupied what is now Laguna Benard, and Silico Lagoon was a bight in the coast under the lee of hills, similar to the present Gorda Bay, and the bight under the lee of Monkey Point.

Later, as the river pushed out a delta, the long and tortuous channel with its flattened slope was unable to carry off the flood volume and this finally burst through the low alluvial apron, along the present bed of the Lower San Juan cutting for itself a more direct channel to the sea. It can easily be imagined then that the large quantity of sediment scoured from the new channel and borne seaward, in addition to the normal sediment load of the river, soon closed Silico and modified the trend of the shore in that locality in such a manner as to compel the discharge of the river in seeking the trough of the sea, to deflect to the northward.

Then began the formation of those lagoons immediately back of Greytown, which were once, without doubt, bights in the shore as was the harbor of Greytown a few years ago, and which were later closed as the harbor of Greytown has recently been.

The sediment brought down by the river, borne away by the waves or deposited upon a deep bottom may for years have no effect. Sooner or later, however, a combination of circumstances, as a heavy flood and a long and severe norther occurring at the same time, dams the river back until an overflow takes place along the line of least resistance to the eastward. This re-

lieves the pressure and at the same time carries a considerable amount of sediment to sea to windward of the main river mouth. This sediment is swept along the shore by the waves until it comes to rest in the quiescent angle between the waves and the main river discharge. Every rainy season then sees an increase in section of the new and shorter channel, and a correspondingly increased amount of sediment discharged from it, and every succeeding dry season sees an accession to the sand spit in the quiescent angle. Finally, this spit extends to and unites with the shore westward; the entire discharge of the river seeks the overflow channel, which becomes the main river; the transference of the river mouth is effected, and the lagoon is born. Years later a second and then a third are formed.

The natural inference of the above is that another bight may in time be formed outside the present harbor of Greytown, and such doubtless would be the case were the formative conditions still the same.

Several circumstances lend color to the belief that the delta of the San Juan is about entering upon an entirely new phase.

An important change has been going on and is still in progress in the regimen of the San Juan itself, namely the transfer of nearly all the volume of the river to the Colorado branch which empties into the sea ten miles to the southward and eastward of Greytown.

The decrease in the volume of the Lower San Juan correspondingly decreases the sediment discharged at Harbor Head and the Tauro mouth.

The sediment discharged by the Colorado has been so acted upon by the waves as to gradually force the

outlet of that river to the southward until at present the waves either beat perpendicularly upon the beach or have a slight southerly resultant.

With the supply of sediment cut off in the vicinity of the delta, and the waves still sweeping diagonally along its northern side, one natural result will follow, viz. : the sand will be cut from the point or eastern half of the delta, and swept into the bight to the westward until the delta is destroyed, and the coast line rectified and hammered into a line normal to the waves.

It would seem that the beginning of this stage had already been attained. The barrier outside of Harbor Head has been eaten through and transported to the westward, and Harbor Head is filling up. The break-water proposed for the restoration of Greytown Harbor will probably modify this rectification to the extent of limiting it to the coast line south and east of the break-water, leaving behind it a secure and permanent basin entirely removed from fluvial influences or dangers.

The scenery of the Lower San Juan and about Greytown, when no silico palms are visible, is no more tropical in character than that of our southern rivers, or the marshes of the St. Mary's River and Cumberland Sound.

From the bifurcation of the Colorado and San Juan to the mouth of the San Carlos, where the river is broad and the luxuriance (in *minutiæ*) of the vegetation of the banks is not perceptible, the effect as one looks along one of the river reaches is not more tropical than that of a Middle State or even New England river in July or August.

Through the Agua Muerta, and for most of the distance between Castillo and Toro, there is, however, no

lack of tropical effects. The huge trees hang covered with luxuriant vines, which twine among the branches, and then fall to the water's edge in dense, heavy curtains, till they form a continuous vertical wall relieved with bastions and flying buttresses.

Above Toro the scenery is even more tropical. Close to the water runs a band of brightest green grass; over this droop the feathery fronds of an unbroken row of palms, and beyond and above the palms towers the fine-cut foliage of great hard-wood trees.

From Greytown to the San Carlos there are now many clearings along the rich bottom lands of the river, the land about the mouth of nearly every tributary having been thus improved. Some of these clearings extend for a mile or more along the river, rich with plantains, bananas, oranges, limes, cacao, coffee, cane and vegetables.

The mouths of these streams offer a secure retreat and harbor for canoes, and the stream itself is a highway to the interior for the hunt, or for *hule* (rubber), or for bringing out the new cedar canoe.

Then over the neighboring spur of hills runs a well-worn trail back into the forest, along which the hunter takes an occasional trip, returning loaded with *chanchos* (wild pigs), *pavon* and *pavo* (wild turkey).

The productiveness of these rich lowlands, when once the flood-waters of the lower river are controlled, and they can be effectively drained, will be wonderful. Below the mouth of the Sarapiquí, and also at Ochoa below the San Carlos, and at Castillo, are large numbers of cattle, and as they gather at the river at night and morning, or feed over the hills during the day, they give a very pastoral air to those localities.

At Castillo there is a village with a population of some hundreds, the picturesque old castle crowning the hill above the village.

The Nicaraguan custom-house is here, and all goods are transferred at this place. There is also something of a garrison in the castle.

At the mouth of the Závalo, just above Toro, there are two or three houses, a depot for supplies for the mines located up the river. At this point also there are thermal springs reputed to be good for rheumatic troubles.

Ft. San Carlos, at the head of the river, is a village of a few hundred inhabitants. There is a garrison here, but the old fort is in ruins.

The scenery of the Upper river is but little changed by high water or low water. In the Lower river there is a marked difference.

In the dry season there is a fringe of grass close to the water's edge, and all the islands have grassy points reaching up and down stream. Banks of yellow sand, favorite haunts of alligators, occur at every bend. Where the banks are vertical, the deep brick red of the clay underlying the soil appears, and at the base of all the spurs which come to the river their bed-rock foundations show. In the rainy season all these features disappear, and the river runs between full banks with the drooping vines trailing upon the water. In March and April these vines put forth their flowers, which hang in long yellow and pink and white festoons. Up in the great cottonwood trees the purple Flor del Toro shows itself, scarlet passion flowers light the woods, the Ibo trees are a solid mass of red flowers, which hide the leaves

entirely ; and another tree, the name of which I do not know, is equally intense in yellow. Then there is a fine white flower growing among the underbrush, which scents the air as with honeysuckle. Along the banks and on the sand-spits running out from the islands, and among the zacate and gramalote grass, grow countless aquatic flowering plants.

Animated nature along the river vies with inanimate in abundance and variety. Though the denizens of the river and the forest can by no means be said to be shy, yet passengers on the steamers have not the opportunities for observation of one traversing the river in a canoe, gliding noiselessly along close under the banks.

If the day be bright every turn in the river shows up a brown, mud-encrusted alligator lying upon the bank, and others poke their ugly snouts above the water.

The triangular fins of sharks may be seen cutting the water here and there : a sudden swirl in the water and a V-shaped ripple moving swiftly away from the canoe marks a startled *tarpon* disturbed at sunning himself in shallow water.

The alligators and sharks, though numerous, I do not consider dangerous. I failed to learn of any authentic instance of their having killed any one, and I have repeatedly seen natives bathing in the river almost literally in the midst of several of the latter.

If near the rapids the river will be full of leaping *závalos*, offering fine rifle practice. Just after sunset a *danta*, or deer, or manatí, is very apt to be seen crossing the river.

White and blue herons stand along the banks or soar lazily from point to point. Macaws, parrots and parro-

quets scream in the trees; *zopilotes*, or buzzards, circle high in the air; an occasional hawk darts swiftly from bank to bank; black and red and black and yellow songsters and trogons flit along the banks.

The sharp eyes of the boatmen detect every now and then a huge iguana hugging a branch above, though sometimes the first intimation of his presence is a splash as he drops into the water from a height, and with a force that it would seem must burst him. Innumerable smaller iguanas, of bright metallic hues, and with ugly spinal fringes, bask upon the white snags and logs which lie in the water near the banks, and when disturbed dart for the shore, moving their feet and tails with such rapidity that they actually walk upon the water, often for a distance of several yards.

Sometimes a dry branch falling in the boat reveals the presence of a troop of monkeys in the trees overhead. These fellows make grimaces, break off dry branches and throw them down, and shake others as if in uncontrollable rage, until a rifle bullet brings down one of the fattest for the boatmen's dinner, and sends the remainder screaming away into the woods.

Perhaps a little farther on a musky odor shows the presence of *chanchos*, or wild pigs, on the bank above, or some of the men may hear them feeding, and it is usually only a matter of a few minutes to bag one of them.

The air above the great river is never silent. From the first suspicion of morning light, when the bull-voiced *congo*, or howling monkey, wakes the forest with his bel-lowings, to sunset, when the shrill whistle of the *gongolona* marks the hour of six, wild pigeons, macaws, song-

birds and monkeys have their turn. At night equally numerous sounds fill the air; the grunting of alligators, the splash of leaping fish, the screams of tigers, and the cries of nocturnal birds and beasts. Then all at once a heavy booming noise, like the distant report of a cannon, breaks through the night air and reverberates along the river; it is the death-note of some giant of the forest which has crashed to the earth, carrying with it everything in its reach.

Or it may be that lying awake upon a sand bank in the river a low whisper comes from the northeast; this increases to a murmur, then to a sound as of surf upon a distant shore. You look to the rubber blanket over you, roll yourself carefully in the one beneath, and by this time the murmur has become a roar. In a moment the bank of the river disappears, and in the next instant the pelting of the big drops upon the blankets, and the hissing of the dry sand as it absorbs the deluge of the tropical shower drown every other sound.

The scenery of the San Juan is more than difficult to describe. From the day when Diego Machuca (1529) floated down its bosom to the Atlantic until now, every traveller upon the noble river has been struck with its wondrous beauty, and wasted words trying to render the impressions it made upon him. It is impossible to do it justice, and it is almost equally impossible to abstain from enthusiastically making the attempt. There are such contrasts. There are days and days upon the river, and there are indescribable nights; days when the turbid water is indistinct through the gray driving rain, and hisses with the impact of the big drops, the tops of the trees hidden in clouds and the banks sodden and

slippery : and days when the vivid greens, waving trees, glistening water, the cool wind sweeping now up, now down the stream, filling the nostrils with fragrant odors, the songs and cries of numerous birds, and the native canoes traversing the river, all steeped in exultant, tropical sunlight, form a wonderful sensuous symphony.

Nights when through the blackest of darkness the men at the paddles, silently and with heads bent to the pouring rain, force the canoe along, every nerve and muscle alert to avert disaster from contact with the frequent snags and logs that project from the banks.

Nights when the Southern Cross and the Northern Bear look down upon the camp on the sand-bank in mid-river ; when brilliant moonlight falls on the softly-flowing river ; when the forest walls on either side stand out as clearly as by day ; when the palm trees glisten like stacks of burnished sabres, while in their hearts crouch blackest shadows.

But it is at the close of day that the noble river flowing from out the crimson and yellow glories of Pacific sunsets, through miles of emerald walls to the Orient mists of the Caribbean, puts on its most royal attire. Then comes the glory of the day ; from the sky descends a flood of rose, of yellow, of pale green light ; from out the flowing river rise other rose and amber and pale green, quivering lights to meet it. In darkest emerald and blackest velvet shadows the great trees rise, sharp etched, against the western sky, with tufts of moss and leaves and rope-like vines, and many of them take on strange forms, here a face, a demon of the jungle, there a majestic stag's head, and there a lithe swaying shape, a naiad of the tropics. From out the

strange, dark forest comes a cloud of fragrance, and the sound of countless birds and beasts and insects.

Then the colored lights fade, but the fragrance and the cries linger, and the white radiance of the moon falls on the noble river.

Back from the river, in the "mysterious wilderness," the "dark forest," the "unknown jungle," of various writers, there are countless objects of interest to those who do not tire easily, and who do not mind a little bodily discomfort. In these forests grow great cedar, almendro, guachipilin, ceiba and cortez trees, their heads towering far up into the sunlight, their bases buried in a dense undergrowth, through which meander the various tributaries of the San Juan. In the upper portion of the river these tributaries are clear, cool mountain streams, rippling over polished rocks and yellow, pebbly reaches, or tumbling in white spray over ledges of black trap.

In the lower river it is necessary to ascend the streams through several miles of rich bottom lands before the mountain section is reached.

Many a memory vignette of varied scenes and adventures in these forests rises before the writer, but want of space precludes a reproduction.

The days along the San Juan are apt to be hot, *i. e.*, 85° to 90°, but the nights are invariably cool, a heavy flannel sleeping suit and a woollen blanket being found very necessary for comfort between midnight and day-break.

As to health, the valley of the river is, with proper sanitary precautions, as healthy a locality as any in Nicaragua or any other country. Colds and their allied

complaints are unknown, and as for malaria, it has been my experience that with good food, regular habits, mosquito bars and coffee, it is a myth. The night, popularly supposed to be the worst time in which to be exposed, was the time frequently selected for travelling upon the river, in order to avoid the heat and glare of the day. To save time I have repeatedly spent several successive nights upon the river, sleeping as best I could in a small canoe, the intervening days being spent in the woods reconnoitering, and have experienced no ill effects.

The mosquitoes so lavishly described by some travellers are by no means the unavoidable torments that many suppose. During the day there are absolutely none, and at night, if camped on a sand-bank in mid-river, or travelling in canoe, they give no trouble. If camped upon the bank a bar is indispensable, but then no one who understands anything about travelling in these countries ever goes without his bar, and it is not the slightest trouble to keep the torments out of this.

The maximum temperature noted on the river during six months, from the middle of Dec., '87, to the middle of June, '88, was 92°, the minimum 64°. The water of the river, though warm and often muddy, is pure and sweet, and, after it has settled and cooled itself in the earthen jars of native make, is by no means disagreeable.

Some reader may ask, How does it happen that in a country so little known in geographical detail as the interior of Central America, there exists such definite knowledge of this river?

It is because from the time men recognized the fact that there is no natural strait across the American

Isthmus, it was seen that at Nicaragua nature had indicated in the most unmistakable way where an artificial passage should be cut.

Twice, as we have already seen, the noble river has borne a rich commerce upon its bosom, once with the tide setting eastward, once westward; and for years, through every vicissitude of despotism intrigue and perverted judgment, it has waited for the day, certain as the recurrence of the seasons, when, between its fertile banks, the stream of the world's commerce shall flow eastward and westward, from ocean to ocean, in constantly increasing volume.

Unless all signs fail this time is close at hand, and in a few years the San Juan and Lake Nicaragua will be alive with white sails and the throbbing propellers of a mighty traffic.